

APPENDIX I

GLOSSARY

APERTURE—See slot.

BOUNDARY CONDITIONS—The two conditions that the E-field and H-field within a waveguide must meet before energy will travel down the waveguide. The E-field must be perpendicular to the walls and the H-field must be in closed loops, parallel to the walls, and perpendicular to the E-field.

BEARING—An angular measurement that indicates the direction of an object in degrees from true north. Also called azimuth.

BUNCHER CAVITY—The input resonant cavity in a conventional klystron oscillator.

BUNCHER GRID—In a velocity-modulated tube, the grid which concentrates the electrons in the electron beam into bunches.

CATCHER GRID—In a velocity-modulated tube, a grid on which the spaced electron groups induce a signal. The output of the tube is taken from the catcher grid.

CAVITY RESONATOR—A space totally enclosed by a metallic conductor and supplied with energy in such a way that it becomes a source of electromagnetic oscillations. The size and shape of the enclosure determine the resonant frequency.

CHOKE JOINT—A joint between two sections of waveguide that provides a good electrical connection without power losses or reflections.

COOKIE-CUTTER TUNER—Mechanical magnetron tuning device that changes the frequency by changing the capacitance of the anode cavities.

COPPER LOSS—Power loss in copper conductors caused by the internal resistance of the conductors to current flow. Also called I^2R loss.

CROWN-OF-THORNS TUNER—See Sprocket Tuner.

CUTOFF FREQUENCY—The frequency at which the attenuation of a waveguide increases sharply and below which a traveling wave in a given mode cannot be maintained. A frequency with a half wavelength that is greater than the wide dimension of a waveguide.

DIELECTRIC CONSTANT—The ratio of a given dielectric to the dielectric value of a vacuum.

DIELECTRIC LOSSES—The electric energy that is converted to heat in a dielectric subjected to a varying electric field.

DIRECTIONAL COUPLER—A device that samples the energy traveling in a waveguide for use in another circuit.

DIRECTIVITY—The narrowness of the radiated beam from an antenna.

DOMINANT MODE—The easiest mode to produce in a waveguide, and also, the most efficient mode in terms of energy transfer.

DRIFT SPACE—In an electron tube, a region free of external fields in which relative electron position depends on velocity.

DUMMY LOAD—A device used at the end of a transmission line or waveguide to convert transmitted energy into heat so no energy is radiated outward or reflected back.

E-FIELD—Electric field that exists when a difference in electrical potential causes a stress in the dielectric between two points.

E-TYPE T-JUNCTION—A waveguide junction in which the junction arm extends from the main waveguide in the same direction as the E-field in the waveguide.

ELECTRIC FIELD—See E-field.

ELECTRONIC TUNING—In a reflex klystron, changing the frequency and output power of the tube by altering the repeller voltage.

ELECTROLYSIS—Chemical changes produced by passing an electrical current from one substance (electrode) to another (electrolyte).

ELECTRON ORBITAL MOVEMENT—The movement of an electron around the nucleus of an atom.

ELECTRON SPIN—The movement of an electron around its axis.

ELEVATION ANGLE—The angle between the line of sight to an object and the horizontal plane.

FARADAY ROTATION—The rotation of the plane of polarization of electromagnetic energy when it passes through a substance influenced by a magnetic field that has a component in the direction of propagation.

FERRITE—A powdered and compressed ferric oxide material that has both magnetic properties and resistance to current flow.

FERRITE SWITCH—A ferrite device that blocks the flow of energy through a waveguide by rotating the electric field 90 degrees. The rotated energy is then reflected or absorbed.

GRID-GAP TUNING—A method of changing the center frequency of a resonant cavity by physically changing the distance between the cavity grids.

GROUP VELOCITY—The forward progress velocity of a wave front in a waveguide.

H-FIELD—Any space or region in which a magnetic force is exerted. The magnetic field may be produced by a current-carrying coil or conductor, by a permanent magnet, or by the earth itself.

H-TYPE T-JUNCTION—A waveguide junction in which the junction arm is parallel to the magnetic lines of force in the main waveguide.

HELIX—A spirally wound transmission line used in a traveling-wave tube to delay the forward progress of the input traveling wave.

HORIZONTAL PLANE—An imaginary plane tangent to and touching the Earth's surface as established by a stable element, such as a gyroscope.

HORN—A funnel-shaped section of waveguide used as a termination device and as a radiating antenna.

HOT CARRIER—A current carrier, which may be either a hole or an electron, that has relatively high energy with respect to the current carriers normally found in majority-carrier devices.

HOT-CARRIER DIODE—A semiconductor diode in which hot carriers are emitted from a semiconductor layer into the metal base. Also called a hot-electron diode. An example is the Schottky-Barrier diode.

HYBRID JUNCTION—A waveguide junction that combines two or more basic T-junctions.

HYBRID RING—A hybrid-waveguide junction that combines a series of E-type T-junctions in a ring configuration.

IDLER FREQUENCY—In a parametric amplifier, the difference between the input signal and the pump signal frequency. Also called the lower-sideband frequency.

INTERACTION SPACE—The region in an electron tube where the electrons interact with an alternating electromagnetic field.

INTERELECTRODE CAPACITANCE—The capacitance between the electrodes of an electron tube.

I^2R LOSS—See Copper Loss.

IRIS—A metal plate with an opening through which electromagnetic waves may pass. Used as an impedance matching device in waveguides.

LEAD INDUCTANCE—The inductance of the lead wires connecting the internal components of an electron tube.

LOAD ISOLATOR—A passive attenuator in which the loss in one direction is much greater than that in the opposite direction. An example is a ferrite isolator for waveguides that allows energy to travel in only one direction.

LOOP—A curved conductor that connects the ends of a coaxial cable or other transmission line and projects into a waveguide or resonant cavity for the purpose of injecting or extracting energy.

LOOSE COUPLING—Inefficient coupling of energy from one circuit to another that is desirable in some applications. Also called weak coupling.

MAGIC-T JUNCTION—A combination of the H-type and E-type T-junctions.

MAGNETIC FIELD—See H-field.

METALLIC INSULATOR—A shorted quarter-wave section of transmission line.

MICROWAVE REGION—The portion of the electromagnetic spectrum from 1,000 megahertz to 100,000 megahertz.

MODULATOR—A device that produces modulation; i.e., varies the amplitude, frequency, or phase of an ac signal.

NEGATIVE-RESISTANCE ELEMENT—A component having an operating region in which an increase in the applied voltage increases the resistance and produces a proportional decrease in current. Examples include tunnel diodes and silicon unijunction transistors.

NONDEGENERATIVE-PARAMETRIC AMPLIFIER—A parametric amplifier that uses a pump signal frequency that is higher than twice the frequency of the input signal.

PHASE SHIFTER—A device used to change the phase relationship between two ac signals.

POWER GAIN—The ratio of the radiated power of an antenna compared to the output power of a standard antenna. A measure of antenna efficiency usually expressed in decibels. Also referred to as POWER RATIO.

POWER RATIO—See Power Gain.

PROBE—A metal rod that projects into, but is insulated from, a waveguide or resonant cavity and used to inject or extract energy.

PUMP—Electrical source of the energy required to vary the capacitance of a parametric amplifier.

RANGE—Distance, as measured from a point of reference, such as a radar, to a target or other object.

REACTANCE AMPLIFIER—A low-noise amplifier that uses a nonlinear variable reactance as the active element instead of a variable resistance. Also called a parametric amplifier.

RECIPROCITY—The ability of an antenna to both transmit and receive electromagnetic energy.

REFLEX KLYSTRON—A klystron with a reflector (repeller) electrode in place of a second resonant cavity to redirect the velocity-modulated electrons back through the cavity which produced the modulation.

REFRACTIVE INDEX—The ratio of the phase velocity of a wave in free space to the phase velocity of the wave in a given substance (dielectric).

REPELLER—Sometimes called a reflector. An electrode in a reflex klystron with the primary purpose of reversing the direction of the electron beam.

ROTATING JOINT—A joint that permits one section of a transmission line or waveguide to rotate continuously with respect to another while passing energy through the joint. Also called a rotary coupler.

SKIN EFFECT—The tendency for alternating current to concentrate in the surface layer of a conductor. The effect increases with frequency and serves to increase the effective resistance of the conductor.

SLOT—Narrow opening in a waveguide wall used to couple energy in or out of the waveguide. Also called an aperture or a window.

SPROCKET TUNER—Mechanical tuning device for magnetron tubes that changes the frequency of the cavities by changing the inductance. Also called a crown-of-thorns tuner.

STAGGER TUNING—A method of klystron tuning in which the resonant cavities are tuned to slightly different frequencies to increase the bandwidth of the amplifier.

STANDING WAVE RATIO—The ratio of the maximum to the minimum amplitudes of corresponding components of a field, voltage, or current along a transmission line or waveguide in the direction of propagation measured at a given frequency.

SYNCHRONOUS TUNING—In a klystron amplifier, a method of tuning which tunes all the resonant cavities to the same frequency. High gain is achieved, but the bandwidth is narrow.

TRANSIT TIME—The time an electron takes to cross the distance between the cathode and anode.

TRANSVERSE ELECTRIC MODE—The entire electric field in a waveguide is perpendicular to the wide dimension and the magnetic field is parallel to the length. Also called the TE mode.

TRANSVERSE MAGNETIC MODE—The entire magnetic field in a waveguide is perpendicular to the wide dimension ("a" wall) and some portion of the electric field is parallel to the length. Also called the TM mode.

TUNNELING—The piercing of a potential barrier in a semiconductor by a particle (current carrier) that does not have sufficient energy to go over the barrier.

TUNNEL DIODE—A heavily doped junction diode that has negative resistance in the forward direction over a portion of its operating range. See **NEGATIVE-RESISTANCE ELEMENT**.

VARACTOR—A pn-junction semiconductor designed for microwave frequencies in which the capacitance varies with the applied bias voltage.

VARIABLE ATTENUATOR—An attenuator for reducing the strength of an ac signal either continuously or in steps, without causing signal distortion.

VELOCITY MODULATION—Modification of the velocity of an electron beam by the alternate acceleration and deceleration of electrons.

VERTICAL PLANE—An imaginary plane that is perpendicular to the horizontal plane.

WAVEGUIDE—A rectangular, circular, or elliptical metal pipe designed to transport electromagnetic waves through its interior.

WAVEGUIDE MODE OF OPERATION—Particular field configuration in a waveguide that satisfies the boundary conditions. Usually divided into two broad types: the transverse electric (TE) and the transverse magnetic (TM).

WAVEGUIDE POSTS—A rod of conductive material used as impedance-changing devices in waveguides.

WAVEGUIDE SCREW—A screw that projects into a waveguide for the purpose of changing the impedance.

WINDOW—See Slot.

WOBBLE FREQUENCY—The frequency at which an electron wobbles on its axis under the influence of an external magnetic field of a given strength.

MODULE 11 INDEX

A

Antenna arrays, 3-13 to 3-15
Antenna characteristics, 3-1 to 3-4
Antenna directivity, 3-2, 3-3
Antenna efficiency, 3-1, 3-2
Antennas, microwave, 3-1 to 3-19

C

Cavity resonators, 1-44 to 1-50

D

Decibel measurement system, the, 2-18 to 2-20
Directional couplers, 1-41 to 1-44

F

Ferrite devices, 1-57 to 1-60
Frequency-sensitive antenna, 3-15, 3-16

G

Glossary, AI-1 to AI-6

H

Horn radiators, 3-9

L

Learning objectives, 1-1, 2-1, 3-1
Lens antennas, 3-10 to 3-12

M

Magnetron, the, 2-23 to 2-36
Microwave antennas, 3-1 to 3-19
 antenna arrays, 3-13 to 3-15

Microwave antennas—Continued

 antenna characteristics, 3-1 to 3-4
 antenna directivity, 3-2, 3-3
 antenna efficiency, 3-1, 3-2
 radar fundamentals, 3-3, 3-4
 reciprocity, 3-3

 frequency-sensitive antenna, 3-15, 3-16
 basic slot antenna and its
 complementary dipole, 3-16 to 3-18

 horn radiators, 3-9

 introduction, 3-1

 lens antennas, 3-10 to 3-12

 delay lens, 3-11

 loaded microwave lens, 3-11, 3-12

 waveguide type, 3-10, 3-11

 reflector antennas, 3-5 to 3-10

 corner reflector, 3-8, 3-9

 cylindrical paraboloid, 3-8

 orange-peel paraboloid, 3-7

 truncated paraboloid, 3-6, 3-7

 summary, 3-17 to 3-19

Microwave components, 2-1 to 2-55

Microwave devices, solid-state, 2-38 to 2-55

Microwave principles, 2-1 to 2-55

 microwave components, 2-1 to 2-63

 decibel measurement system, the, 2-18 to 2-20

 microwave tube principles, 2-2 to 2-10

 microwave tubes, 2-10 to 2-17

 solid-state microwave devices, 2-41 to 2-58

 summary, 2-59 to 2-63

Microwave tube principles, 2-2 to 2-10

Microwave tubes, 2-10 to 2-17

R

Radar fundamentals, 3-3, 3-4

Reciprocity, 3-3

Reflector antennas, 3-5 to 3-10

S

Solid-state microwave devices, 2-41 to 2-58

T

Tubes, microwave, 2-10 to 2-17

W

Waveguide devices, 1-41 to 1-56

Waveguide junctions, 1-50 to 1-56

Waveguide theory and application, 1-1 to 1-61

introduction to waveguide theory and
application, 1-1, 1-2

waveguide devices, 1-41 to 1-56

waveguide theory, 1-2 to 1-41

summary, 1-61 to 1-65